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# Navigating a trilemma: Energy security, equity, and sustainability in the Philippines' low-carbon transition

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ABSTRACT

Nearly a decade after the Philippines began promoting renewable energy through legislation, the country has seen gains and encountered roadblocks in its transition to low carbon. This paper examines the Philippines' experience in attempting to escape conditions of lock-in and path dependency on fossil fuels, and attempting a governed transition to low-carbon energy sources. The Philippines is a developing country with substantial economic growth aspirations, yet it is among the most vulnerable to climate change, so it has great interest in mitigating global carbon emissions. Yet, the country itself is heavily dependent on imported coal for its energy needs. In the context of its existing regulatory and techno-institutional landscape, the authors examine the Philippine experience in governing its energy transition. The paper discusses challenges in balancing the trilemma of energy security, equity, and sustainability. It then identifies some priorities for the Philippines as it attempts to move away from fossil fuel dependency and accelerate its transition towards low-carbon energy. The authors consider developments beyond the energy sector, particularly the early entry-into-force of the Paris Agreement, as a tool to favor the trilemma's sustainability pillar. The Philippine case may provide lessons for other developing countries undergoing their own transitions.

## 1. Introduction

Scholars like Sovacool, Kern and Rogge posit that future energy transitions can take place much faster than past ones, which were largely left to market forces and, consequently, dependent on the pace of technological innovations [1–3]. 'Historical' [2] or 'emergent' [3] transitions were generally driven by opportunities for economic gain. In contrast, future transitions could be driven by global problems that need addressing, like climate change and resource scarcity [2,3]. To meet these challenges, countries envision an energy future, then enact policies and legislation to realize that vision. This way, countries try to govern their transitions. A country's active management of energy transition through laws, policies, and incentives that shape markets helps accelerate the pace of these transitions [2,4]. This paper examines the Philippines' experience in attempting to govern its energy transition to accommodate low-carbon sources in its energy mix. Specifically, the paper tackles questions that have spurred intense debates in various policy fora within the Philippine energy sector: "What key challenges does the Philippines, a rapidly growing nation, face as it attempts to transition to a low-carbon future? What low-hanging opportunities and policy levers can decision makers prioritize to minimize impediments to reaching the country's energy security and equity goals, as it plans its low-carbon transition?"

This section sets the context and provides a background on the Philippines; Section 2 describes the research method; Section 3 lays down the Philippine regulatory framework for energy and discusses the techno-institutional complex and path dependencies that policymakers must contend with in formulating transition policies; Section 4 discusses challenges the Philippines has encountered in prioritizing the energy trilemma's sustainability pillar and shifting its energy landscape to accommodate renewables; Section 5 discusses opportunities for the future of Philippine energy policy and identifies key priorities in managing the transition; and Section 6 provides a brief conclusion.

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### 1.1. The Philippines

The Philippines is an archipelago of 7,641 islands in the Western Pacific [5], with a population of 100.98 million as of August 2015 [6]. Its population grows at an average of 1.85% annually [7], higher than the world average of 1.182% [8]. It is currently a lower middle-income country [9,10]; however, it has been one of the fastest growing economies in Asia [11,12]. Over the past six years, the Philippine economy grew by an average of 6.2%, with growth expected to continue at 6.5–7.5% in 2017 [13]. The Asian Development Bank expects the Philippines to graduate into an upper middle-income country by 2020 [14].

To support the growing population and economy, the Philippine Department of Energy (DOE) anticipates the need for a total installed capacity addition of 43,765 megawatts (MW) by 2040, with 24,385 MW for Luzon, 9180 MW for Visayas, and 10,200 MW for Mindanao [15]. As of June 2016, the Philippines' installed capacity was 20,055 MW, of which 33.99% was from renewable energy, 33.24% was from coal, 18.8% was from oil, and 14.32% was from natural gas. However, gross generation figures show that coal generated 46%; renewable energy, 24%; natural gas, 24%; and oil, 6% [16]. In governing its energy transition, the Philippines aims to increase the share of renewables in its energy mix.

### 1.2. Climate vulnerability

As an archipelago in the Western Pacific Ocean, the Philippines lies within the typhoon belt and the Pacific ring of fire [10,19]. It is especially vulnerable to extreme weather events such as typhoons, floods, and rising sea levels [20,21]. The Global Climate Risk Index 2017 ranks the Philippines as the world's fifth most affected by extreme weather events and other natural hazards like earthquakes [22], even while global average temperature increase is still at +1 °C above pre-industrial levels. In the last decade, for example, record-breaking tropical cyclones like Super-typhoon Haiyan have devastated the country, resulting in substantial losses of life and property and affecting the country's productivity [19]. Moreover, the Intergovernmental Panel on Climate Change (IPCC) predicts that more intense and more frequent precipitation events will result from an increase in global mean surface temperature, especially in the tropics [23]. Thus, the Philippines cannot afford to ignore climate change despite its substantial economic growth aspirations. It must include climate considerations in developing its national energy and economic development policy agenda [24].

However, as Silveira and Johnson suggest, "[t]he global transition to an environmentally sustainable economy will require radical re-organization in the structure of energy systems [25]." Since energy production and consumption are substantial sources of greenhouse gases, contributing about 65% of global emissions [26], energy policy changes are critical to achieving environmental sustainability. "Energy is at the heart of the problem and so must be integral to the solutions [27]." In light of these, the Philippines has been attempting to transition its energy system to low carbon. This paper studies the Philippine experience in this effort.

## 2. Methods

Mixed methods were used to gather data for this study. Data was collected from both written and oral sources using archival research, desktop reviews, key informant interviews, expert workshops, and a multi-stakeholder policy dialogue.

The research team conducted an extensive literature review on energy policy and governance and held key informant interviews, supplemented by archival data collection of official government records, throughout a six-month research period, from May to October 2016. Desk-based research was conducted on the current regulatory framework for energy, supplemented by validation interviews with selected high-level officials involved in national policy planning and implementation. The team conducted a total of 28 interviews with key officials from fourteen national government offices, three international organizations with development cooperation projects in the Philippines, and two development specialists with expertise on the Philippines, *viz* (Table 1).

**Table 1**
Research Participants.

| | |
|---|---|
| National government offices | |
| 1. DOE Office of the Undersecretary | 2 |
| 2. DOE Energy Policy and Planning Bureau | 2 |
| 3. DOE Electric Power Industry Management Bureau | 2 |
| 4. DOE Renewable Energy Management Bureau | 1 |
| 5. National Renewable Energy Board | 1 |
| 6. Energy Regulatory Commission | 2 |
| 7. Climate Change Commission | 4 |
| 8. Senate | 2 |
| 9. House of Representatives | 2 |
| 10. Office of the President | 1 |
| 11. Department of Transport | 1 |
| 12. Department of Environment and Natural Resources (DENR) Office of the Undersecretary | 1 |
| 13. DENR Environmental Management Bureau | 1 |
| 14. DENR Climate Change Office | 1 |
| International organizations | 3 |
| Development specialists | 2 |

Research participants were identified by selecting government agencies involved in the formulation, planning, and implementation of energy and climate policies at the national level. Thereafter, a snowball method was employed, with the research team interviewing specialists and other resource persons recommended by research participants.

Most of the persons contacted agreed to be interviewed, and the interviews were completed over four months. The interviews employed an initial, semi-structured portion involving a series of relatively standard questions about current energy and climate policies and those that were being discussed or planned, followed by an unstructured, open-ended segment where research participants were invited to speak freely about the challenges they encountered in energy and climate policy planning and implementation in general, and in handling energy transition in particular.

Findings from the study were presented and extensively validated in expert workshops on September 5 and 6, 2016, attended by representatives from the private sector (representing both fossil fuels and renewables), from government/regulatory agencies, and from aid agencies involved in the formulation of climate change mitigation plans for the Philippines (*e.g.*, USAID-Building Low Emission Alternatives to Develop Economic Resilience and Sustainability (B-LEADERS) Project). This was capped by a high-level multi-stakeholder policy dialogue with representatives from the legislative and executive departments, the private sector, civil society organizations, and the academe. Inputs gathered from the expert workshops and policy dialogue were incorporated into this study.

In addition, the paper also relies on appropriate scientific literature, data provided by relevant government agencies, results of studies commissioned by government agencies and international organizations, information provided by industry association reports, and data from veteran negotiators for the Philippines in the international climate negotiations.

## 3. Regulatory and techno-institutional landscapes

Regulatory and techno-institutional landscapes can result in path-dependency or lock-in. This means that the extant architecturally-linked systems of laws, technologies, and institutions that allow energy to be produced, and transported to consumers seamlessly, create "systemic market and policy barriers to alternatives [28]: 818." In other

words, well-entrenched and developed systems make it difficult for new technology to come in quickly, at large scale. This section discusses the Philippine regulatory framework for energy regulation, and then examines the techno-institutional landscape, focusing specifically on energy sources the Philippines currently relies on. These are factors that result in path dependency, or lock-in conditions, and low carbon strategies will have to remove this path dependency.

### 3.1. Regulatory framework

Severe power shortages and unstable energy supplies in the late 1990s spurred the Philippine government to fundamentally restructure and liberalize its electricity sector [18]. This led to the passage of an energy reform law (called EPIRA) that became the core of the national legal framework on energy. It is this system that the law on renewable energy (RE) sought to transform, through the promotion of RE, to enable the latter to compete with dominant fossil fuel sources.

#### 3.1.1. Prioritizing energy security through EPIRA

In 2001, Congress enacted the Electric Power Industry Reform Act (EPIRA) [29], which privatized the industry [18]. The law divided the once vertically integrated sector into four: generation, transmission, distribution, and supply. The generation sector, comprising power plants, generates electricity, which then passes through the high voltage transmission lines that compose the national grid (the transmission sector), and then through the lower-voltage distribution lines (the distribution sector) that connect to consumers. The sale of electricity to consumers makes up the supply sector.

In reforming the industry, the government declared that it would completely divest from and privatize the generation sector. Although generation remained a public interest, it was deregulated. As of December 2016, or fifteen years later, the DOE reported that the divestiture was still underway, with 650 MW of generation assets and 230.75 MW of independent power producer (IPP) contracts still pending privatization [30]. The transmission sector, which operates the national grid, remained a state-owned monopoly under the National Transmission Corporation (Transco). However, in 2009, the maintenance, operation, and further expansion of the national grid were awarded to a private concessionaire, the National Grid Corporation of the Philippines (NGCP), for 50 years, through a legislative franchise [31]. Nevertheless, the Energy Regulatory Commission (ERC) retained regulatory power over the tariffs the NGCP can impose. The distribution sector, which provides the service of distributing electricity from the grid to the consumers through their distribution lines, remained regulated as a public utility. The service providers in this sector, called distribution utilities (DUs), could either be private DUs or electric cooperatives. In either case, they need Congressional franchises to service a particular area. Finally, the suppliers in the supply sector could be generation companies that sell directly to end-users or DUs which, in addition to providing distribution services, choose to perform supply functions by buying electricity from generation companies and then selling it to consumers.

#### 3.1.2. Promoting renewables through the RE Act

In 2008, with the EPIRA reforms still underway, Congress passed the Renewable Energy Act (RE Act) to encourage the development of renewables [32]. Considered a milestone law [33], the RE Act provided a national directive to encourage the use of RE by attracting RE developers through fiscal incentives or structural policy. Fiscal incentives include the feed-in-tariff (FIT), income tax holidays, tax credits, and cash incentives. Structural policies include the renewable portfolio standards (RPS), RE market, green energy option, and the must-dispatch rule. The RPS requires a portion of electricity to be procured from renewables; the RE market is intended to be the trading platform for RE; the green energy option is envisioned to provide contestable customers[1] the option to purchase electricity from RE sources; and the must-dispatch rule is a tool to require all intermittent RE that enters the grid to be dispatched immediately [34]. Today, while most fiscal incentives have already been implemented, structural policies except for the must-dispatch rule have mostly been relegated to the backburner.

### 3.2. Techno-institutional complex

In addition to its regulatory landscape, a country's existing technologies and the complex infrastructure, systems, and institutions built around them also create path dependency or lock-in conditions [4]. As returns to scale are gained for embedded technologies, it becomes increasingly difficult for new, external sources to penetrate an energy system. This section examines the different fuel sources that the Philippines currently depends on, and the techno-institutional landscape that has emerged. It then looks at key domestic considerations for each fuel, as a starting point for discussion about how deeply entrenched a particular fuel is in the Philippine energy system. The greater the dependency is on a particular fuel, the greater the lock-in and, so, the more challenging it will be for the Philippines to eliminate its dependency on such a fuel.

#### 3.2.1. Coal

Coal-fired power plants primarily serve the baseload demand of the Philippines. Presently, it is the cheapest fuel, with a contract price ranging from Php2.90–3.50 (USD0.06–0.07)[2] per kilowatt-hour (kWh) [35]. However, if a coal plant is not operating at 60% or more dispatch capacity (which is often the case whenever coal plants are not used as baseload), the actual generation cost becomes higher than the contract cost. Thus, the actual cost can range from Php4.00–4.80/kWh (USD0.08–0.09) [35]. This does not yet reflect the social costs of coal. Grausz calculates the total external cost of coal as USD57-58 per megawatt-hour (MWh) compared to USD30/MWh for natural gas, USD2/MWh for wind, USD6/MWh for solar, and USD11/MWh for biomass [36]. Once these externalities are internalized, coal becomes more expensive than natural gas, wind, and biomass.

Apart from the social costs of coal, there is also the issue of import dependence in the Philippines. DOE data show that around 68% of the country's coal is imported, and 95.80% of the importation is from only one country: Indonesia [37]. Power generation alone uses 79.77% of the Philippines' total coal stock, which includes local production and importation. The dependence (a) on imported coal and (b) on coal as a major power source highlights the exposure of electricity prices to international market fluctuations. Table 2 illustrates the variation in the benchmark thermal coal price of Indonesia from 2012 to 2017. As can be seen, the coal price in February 2017 is at USD 83.32 per ton. A year ago, in February 2016, it was only USD 50.92 per ton.

#### 3.2.2. Renewable energy

RE is attractive for the Philippines because it is (1) indigenous, and (2) environmentally sustainable. However, costs and challenges vary for each renewable resource. Conventional renewables, such as geothermal and hydropower, are cheaper to generate than emerging renewables such as wind, solar, biomass, run-of-river hydro, and ocean, especially since the price of the latter is pegged to their designated feed-in-tariff. Also, conventional renewables can serve as baseload and, with hydropower, also as peaking. The National Renewable Energy Program

[1] The Philippines' Energy Regulatory Commission (ERC) defines "contestable customers" as electricity end-users who have a choice of supplier of electricity based on their electricity requirements [96]. As of December 26, 2016, the ERC designated those end-users that need at least 1 MW of electricity per month as mandatory contestable customers. This threshold for mandatory contestability is to be gradually reduced based on a schedule (to 750–999 KW as of June 26, 2017, then to 500 KW as of June 26, 2018) to be reviewed by the ERC [97].

[2] Throughout this paper, the prevailing rate as of August 15, 2017 (xe.com/ucc), at Php 51.2098 to USD 1 (USD 0.0195142 to Php 1), is used.

**Table 2**
Indonesian Government's Benchmark Thermal Coal Price (in USD/ton), various years. Source: Indonesian Ministry of Energy and Mineral Resources [37].

| Month | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|
| January | 109.29 | 87.55 | 81.90 | 63.84 | 53.20 | 86.23 |
| February | 111.58 | 88.35 | 80.44 | 62.92 | 50.92 | 83.32 |
| March | 112.87 | 90.09 | 77.01 | 67.76 | 51.62 | |
| April | 105.61 | 88.56 | 74.81 | 64.48 | 52.32 | |
| May | 102.12 | 85.33 | 73.60 | 61.08 | 51.20 | |
| June | 96.65 | 84.87 | 73.64 | 59.59 | 51.87 | |
| July | 87.56 | 81.69 | 72.45 | 59.16 | 53.00 | |
| August | 84.65 | 76.70 | 70.29 | 59.14 | 58.37 | |
| September | 86.21 | 76.89 | 69.69 | 58.21 | 63.93 | |
| October | 86.04 | 76.61 | 67.26 | 57.39 | 69.07 | |
| November | 81.44 | 78.13 | 65.70 | 54.43 | 84.89 | |
| December | 81.75 | 80.31 | 69.23 | 53.51 | 101.69 | |

(NREP), which the RE Act charges the DOE with executing [38,39], states that indicative geothermal projects (expected to run 2014–2026) have a potential capacity of 1,425 MW. However, the World Energy Council [40] has stated that these projects face one substantial barrier: the high financial risk (which includes development uncertainties arising from drilling and well tests) in comparison with other energy sources.

Hydropower's share in power generation has been decreasing over the years but NREP [41] is targeting a 3,161 MW of hydropower capacity addition by 2016–2020, and another 1,891.8 MW addition by 2021–2025. Hydropower, just like geothermal power, requires large capital costs and a long gestation period. Yet, unlike geothermal, hydropower is season-dependent and the water supply may decrease to a level where the plant cannot be operated. This is because the Philippines does not upcycle water, since hydropower dams are usually used for multiple purposes including irrigation and water quality management.

Intermittent emerging renewables, such as solar, wind, run-of-river hydro, and ocean, have been characterized as must-dispatch technologies. Biomass, although a non-intermittent emerging renewable, is considered a priority dispatch resource. It also provides baseload capacity. Its challenge lies in sourcing the feedstock used to produce energy. The Biomass Renewable Energy Alliance has also mentioned two additional hurdles: (1) stricter requirements for biomass plants since they are considered waste-to-energy projects, and (2) the Department of Agriculture's moratorium on conversion of agricultural lands, as most biomass plants are located in agricultural lands [42]. Run-of-river hydropower is cheaper compared to traditional hydropower. However, there has been minimal investment in it because of its long gestation period compared to solar and wind.

### *3.2.3. Natural gas*

Natural gas plants are used in the Philippines as baseload and mid-merit plants. However, they are ideally mid-merit plants because they have more flexibility than coal plants in terms of ramp rates, minimum load, and startup time [43]. This makes natural gas the best complement for RE, to address the latter's intermittency [44]. Natural gas combined-cycle plants (both conventional and advanced) also have the second lowest levelized cost of energy (LCOE) among dispatchable technologies, next to geothermal. Moreover, in the Philippines, it has a lower LCOE than biomass, wind-offshore, solar PV, solar thermal, and hydropower [45]. Natural gas is less expensive than coal if coal plants operate at less than 60% dispatch capacity [46].

However, the price of natural gas is still subject to international market volatility because it is linked to the foreign exchange. In terms of carbon dioxide ($CO_2$) emissions, natural gas is lower by about 2/3 per million ton compared to coal. In the Philippines, natural gas comes from two sources: the Malampaya and Libertad gas fields. Malampaya is expected to be depleted by 2024–2030. Without viable alternative sources, its depletion poses a big threat to Philippine power generation. The Lantau Group [47] estimates that the cost of replacing natural gas from Malampaya during outages alone is USD 230 million net present value. Natural gas plants are starting to prepare for this contingency through the creation of LNG terminals. Still, this would mean importing natural gas and exposing the country to the same risks as importing coal for power generation.

### *3.2.4. Oil*

An oil-fired power plant is best used as a peaking plant because of its rapid response – it is quicker than natural gas plants. An oil plant is also highly reliable and can produce power non-stop. It has a special niche in the Philippine market because it serves the off-grid areas where the main source of energy is diesel. Still, oil is the most expensive among the fossil fuels and, like coal, its price is extremely volatile because of international market fluctuations [4]. To illustrate, in November 2014, the average generation cost of oil was Php 24.72/kWh (USD0.48/kWh) [48]. The next month, it almost doubled to Php 43.98/kWh (USD0.86/kWh) [49]. When January 2016 came, it plummeted downward to Php 15.42/kWh (USD0.30/kWh) [50]. As To et al. pointed out was the experience in Mauritius before the 1990s [4], reliance on oil means the Philippines remains vulnerable to extremely volatile energy prices.

## 4. Challenges in governing the transition

The previous section outlined the overarching regulatory and technological frameworks both guiding and constraining energy development in the country. EPIRA provided the general framework for the power industry while the RE Act provided the policy direction for the use of RE resources. These two were supposed to complement each other. However, the implementation of both laws has been fraught with challenges and has revealed difficulties in prioritizing one pillar of the trilemma in favor of others. This section discusses the challenges the Philippines has experienced in trying to satisfy the sustainability pillar, particularly its effects on the security and equity pillars.

### *4.1. Navigating a trilemma*

Policies should balance the differing, overlapping, and sometimes contradicting, objectives of the energy trilemma of security, equity, and sustainability. The World Energy Council defines energy security as the "effective management of primary energy supply from domestic and external sources, the reliability of infrastructure and the ability of participating energy companies to meet current and future demand;" equity as the "accessibility and affordability of energy supply across populations;" and environmental sustainability as the "achievement of supply and demand-side energy efficiencies and the development of energy supply from renewable and other low-carbon sources [51]." Sovacool and Saunders posit that affordability and sustainability are already incorporated in energy security, along with availability, resilience, and governance [52]. They argue these "dimensions can create distinct priorities and risks," making energy security "intrinsically relative" to each country [52].

Hughes acknowledges the multifaceted and unique nature of energy security for each jurisdiction and proposes four "Rs" for policymakers to easily identify and discern what falls within its ambit: (1) **review** existing sources, suppliers, and supplies of energy, infrastructure, energy services, energy intensities, and potential secure energy supplies; (2) **reduce** energy demand through energy conservation and/or energy efficiency; (3) **replace** insecure energy supplies with secure ones through diversification and/or changing infrastructure; and (4) **restrict** new demand to secure sources [53]. These 4Rs show the complexity of achieving energy security with equity and sustainability since it will require demand- and supply-side interventions amidst changing technologies and global and local economic conditions.

In the Philippines, the RE Act provides certain mechanisms to

promote RE. These skew towards the sustainability pillar of the trilemma, and also create a way out of fossil fuel dependency. For example, the must-dispatch rule under the RE regulations grants preference to intermittent RE in the dispatch schedule whenever generation is available. NGCP had to manage this at the onset of variable RE in the system, because the Philippine Grid Code [54] charges NGCP with the obligation to ensure grid reliability by maintaining the system frequency at 60 Hz under pain of penalty from the ERC. Given this and the inability of intermittent sources to provide energy at all times, there was a need to (1) provide sufficient regulating reserves, and (2) ensure the resources used as reserves can ramp up and down quickly enough to address the duck curve. Unfortunately, there appeared to be insufficient preparation for the arrival of variable renewables. In 2015, a year after their introduction, the frequency load violations of NGCP increased by 41.28%, compromising overall grid stability and reliability. Significantly, it cannot be said with certainty that the must-dispatch rule was the reason behind the fluctuations. Nevertheless, the experience brought to light two key considerations. *First,* it indirectly highlighted the continuing need for certain fossil fuels such as natural gas and diesel to address RE's intermittency. Admittedly, hydropower and battery storage can provide the same services as natural gas and diesel; however, the rated capacity of hydropower plants is dependent on hydrologic conditions, while battery storage technology has not reached commercial viability in the Philippines. *Second,* the rule has, in certain instances, led to renewables displacing fellow renewables, as in the case of Negros Island where the oversupply of solar power has displaced geothermal power. This example shows serious difficulties encountered in prioritizing the sustainability pillar, and how the must-dispatch mechanism hindered security and equity (especially access).

Affordability in power supply, another component of energy equity, is also a policy objective of the EPIRA. Yet, the implementation of the FIT under the RE Act has resulted in additional costs passed on to the consumer, which could have been avoided, or even lessened, because of the dwindling global RE prices. To illustrate, Lazard [55] estimates that the LCOE for solar in 2009 ranged from USD323–394/megawatt hour (MWh). The five-year period thereafter saw a 78% decline in the LCOE so that by 2014 it ranged from USD72–86/MWh. The continuing decrease is reflected in power supply contracts awarded in various parts of the world. In 2016, solar contracts were awarded after competitive bidding at Php 1.21/kWh (USD0.02/kWh) in UAE, Php 1.46/kWh (USD0.03/kWh) in Chile, Php 1.64/kWh (USD0.03/kWh) in Mexico, Php 2.4/kWh (USD0.05/kWh) in Peru, and Php 3.35/kWh (USD0.07/kWh) in Zambia [56]. Even in the Philippines, the country's largest DU, the Manila Electric Company (or Meralco), was able to sign a power supply agreement with a solar developer at Php 4.69/kWh (USD0.09/kWh) in 2016. Regrettably, however, despite the price of solar taking a nosedive globally, Philippine consumers were stuck with having to pay the FIT amounts allocated pursuant to the RE Act. In 2012, the FIT for solar was awarded at Php 9.68/kWh (USD0.19/kWh) for 74.12 MW. This was followed by a second round in 2016 at Php 8.49/kWh (USD0.17/kWh) for 451.83 MW [57].

Through the FIT regulations, the country had committed its consumers to paying fixed prices for solar technology, even if the FIT, which was meant to make solar competitive vis-à-vis other energy sources, was no longer warranted once global solar prices had dipped drastically. The impacts of policies on energy equity cannot be downplayed, because it is the consumers who ultimately bear the burden of subsidies. With the FIT, for example, consumers are burdened through mandatory payments of the FIT allowance, a component of the electric bill. Initially the FIT allowance was at Php 0.04/kWh (USD0.0008/kWh), but it was tripled to Php 0.12/kWh (USD0.0023/kWh) to accommodate the increase in installation targets and the low prices in the wholesale electricity spot market. Recently, the ERC approved a FIT allowance of Php 0.18 (USD0.0035) [58]. However, there is a pending application for a Php 0.22 (USD0.0043) FIT allowance to pay the outstanding Php6.6bn (USD129m) obligation to FIT-eligible developers [59]. The repercussions on cost will continue to be felt by consumers for approximately 20 more years due to the term of solar energy service contracts. This is another example showing how the pursuit of the sustainability pillar has impaired the equity pillar of the trilemma (in this particular case, the affordability component of the equity pillar).

There is also the question of "stranded" solar projects – those built with the hope of being awarded FIT eligibility certificates but which have been unable to qualify. These projects amount to an estimated 300 MW, built at a price regrettably far more expensive than the present cost of solar [60]. The Philippine experience with the FIT confirms the effectiveness of a subsidy to spur investment in RE sources, particularly solar, but it also underlines the danger of government guarantees especially in a privatized industry highly vulnerable to rapid, disruptive technology changes. Ultimately, government guarantees are collected from consumers in the form of taxes, which eventually raise overall electricity prices.

The foregoing examples buttress the argument that the Philippines cannot transition to low carbon without considering its economy-wide effects. Policymakers are unwilling to sacrifice the availability of reliable energy, and alternative sources cannot be prohibitively expensive. This means viable transition fuels must be identified to ensure that energy security and equity are not compromised, minimizing potential resistance against renewables. Nonetheless, emerging technologies must be given space to come in and exploit market changes in demand and supply, so that, ultimately, consumers can reap the benefits of competitive, cleaner technology. Scalable alternatives must be enabled to displace and eventually phase out fossil fuels as primary energy sources. Where price hinders the uptake of low-carbon sources, sufficient funding support must be mobilized to scale up and sustain the transition to renewables. To ensure that the policy changes are acceptable to diverse stakeholders, it is desirable for policymakers to engage the whole of society in developing low-carbon policies [4]. All these are easier said than done. These difficulties in navigating the energy trilemma and finding the appropriate balance for the Philippine context indicate that, perhaps, policymakers can prioritize one pillar in a particular timeframe (*e.g.*, short-term) and then progressively work towards the other pillars (*e.g.*, in the medium to long term). In addition to these, there are institutional challenges that impede the transition to low carbon, which will be discussed in the next section.

### *4.2. Institutional challenges: regulatory instability and uncertainty*

With the desire to transition out of a fossil fuel economy comes the necessity of attracting more RE developers whose decisions are largely influenced by regulatory stability and certainty. Government policy in the Philippines is largely dependent on the priorities of each administration and the direction provided by the Secretary of Energy, a presidential appointee. Thus, although the EPIRA and the RE law provide the guiding principles for legislative policy, the Energy Secretary has great discretion to decide how the laws will be implemented and which programs to prioritize. To illustrate, in 2014 the DOE focused on formulating an optimal energy mix for the entire sector. After the national elections in 2016, the new administration moved away from an optimal energy mix policy and instead emphasized the need to meet the country's capacity requirements, thus prioritizing energy security, regardless of technology (fossil fuels or RE) [66]. The changing priorities of each administration are also reflected in the country's numerous, varying energy plans, and accentuated by the lack of a single, coherent, long-term plan that different government administrations are bound to. Sareen, in a study of institutional bottlenecks and path dependency that hinder energy transition in two Western Indian states, observed that in Rajasthan, each election term brings a shift in political vision that result in a lack of a single coherent policy, particularly in the distribution sector [67].

In addition to constantly changing policies, red tape at the national

and local levels displace the much needed assurance that investments will be protected by stable regulations and that investors will be given time to recoup their investments. For one, the permitting process for both conventional and renewable generation projects is laden with challenges. To illustrate, the procurement of permits for a hydropower plant has been estimated to take 1,300 days and require 165 signatures from different government agencies [61]. This duration is for the permitting process *alone*, it does not yet count the time needed to construct the plant. The same challenge has been identified by Sareen with small solar developers and wind turbine installers finding themselves "mired in red tape and delays to access permits and subsidies" [67].

While it may be tempting to consider regulatory changes as evidence against lock-in conditions, the Philippine experience actually clearly shows the opposite: while heads of agencies and high-level priorities may change, the bulk of the bureaucracy remains the same and growth in their know-how has consistently lagged. Bureaucratic knowledge and capabilities create institutional-path dependencies because regulators can only regulate what they know. Since most technological advancements come from the private sector, government regulators constantly have to catch up with rapidly evolving technologies. Before they do, regulations are limited to technologies the regulators know and understand. Thus, when new technologies come in, their proponents often have to deal with regulations meant to apply to their industry, but which are in fact obsolete in relation to their particular technology.

Another challenge is the differing processes and requirements in the local government units (LGUs) starting with the barangay, then the municipality or city, and lastly the province. RE sources also face a distinctive barrier which may not be present in most hydrocarbon technologies. Many RE-viable areas are found in the ancestral domains and lands of indigenous peoples (IPs) to whom the Philippine Constitution has granted special rights. There is no assurance that IPs will give the required free, prior, and informed consent to the extraction and use of these resources. Furthermore, the consent of *all* IPs in the affected area is required. Thus, even if only one out of ten indigenous tribes refuses, no free, prior, and informed consent certificate can be issued. All these, to a certain extent, can discourage greenfield RE generators from entering the Philippine market.

### 4.3. Techno-institutional challenges: difficulties in responding to rapid technological developments

Limited investment in renewables cannot be attributed solely to the lack of stability and certainty in government policies. There are also technical limitations that bar the entry of new RE developers, such as the insufficiency of the grid infrastructure and difficulties in keeping up with rapid technological developments.

#### 4.3.1. Grid infrastructure

The best illustration for this shortcoming is the situation of the national grid. The Philippines has two main unitary grids: the Luzon-Visayas grid, and the Mindanao grid. The lack of connection between Luzon-Visayas and Mindanao has proven costly at times, particularly when there is a shortage in one area and an oversupply in the other. There are also limitations within the Luzon-Visayas grid itself. It is expected that the capacity of the drawdown substations serving Metro Manila, the load center of the Luzon grid, will no longer be adequate in the coming years due to increasing demand. Furthermore, there is just a single transmission line from these drawdown substations to Metro Manila. The need for augmentation through new transmission lines, new substations, new double lines, and most importantly, a loop system has been recognized by NGCP because the current condition not only compromises reliability, but also inhibits the entry of new developers in Luzon. In the Visayas, it is essential to establish the Cebu-Negros-Panay backbone, and develop the Cebu-Bohol link. Currently, there is excess supply from solar power in Panay, Negros, and Cebu that cannot be brought to Bohol and the other neighboring areas because of the capacity restrictions of the extant transmission lines. These highlight the inadequacy of the current grid to accommodate the increasing energy supply, and the transmission provider to expediently construct the necessary infrastructure to accommodate additional energy supply, and/or replace it with a smart grid. The lag between the construction of new generation projects and reinforcements to the grid can be attributed to the absence of a firm policy on the location of new plants vis-à-vis the available grid capacity. NGCP can only recommend new sites to developers, but it is the latter who ultimately decides where to set up their plants. Based on developers' preferences, NGCP is then obliged to arrange for the necessary grid connection.

Significantly, efforts to increase inter-island connections do not include missionary areas. These are either off-grid, far-flung, remote, or (commercially) unviable areas. Considering the Philippines' archipelagic nature, both the EPIRA and the RE law have promoted off-grid solutions to address what Alstone et al. call "energy isolation barriers" arising from the geographic and economic remoteness of these areas [62], leading to energy poverty. The National Power Corporation–Small Power Utilities Group (NPC-SPUG) is responsible for ensuring missionary electrification and providing power generation in these localities. Missionary electrification remained at 62.03% as of December 2016 [63]. Off-grid areas, numbering 238, are primarily served by bunker-fired diesel generators and are subsidized by on-grid customers through the universal charge for missionary electrification (UC-ME) [63]. The UC-ME, at Php 0.1561/kWh (USD0.003/kWh), covers a part of the generation charge and provides a cash incentive for RE developers. Despite this, there has been little uptake in off-grid areas. While an analysis of the reasons for this is beyond the scope of this paper, the small RE uptake in missionary areas indicates a need to push for community energy.

#### 4.3.2. Rapidly evolving technology

Apart from the inability to keep up with supply and demand, policymakers have also been unable to foresee how advancements in technology may affect the current policy landscape. This exemplifies the classic case of regulators having to play catch-up with technological innovations. This results in either an absence of a policy issuance on new technologies or, where there is a written policy, a tendency for these policies to become too restrictive. The Philippine Solar Alliance [64] has stated that it takes three months to a year to acquire a net meter for rooftop solar, and the buy-back rate is pegged only to the blended generation rate of the DU. In addition, there are no institutionalized policy instruments governing distributed generation, battery storage (both as a generation source and as regulating reserve), floating solar, micro-grids, and community RE. Some of these new technologies and concepts have already entered the Philippine market, albeit at a relatively slow pace. The Philippines can look to other country examples as it crafts policies on these matters. For example, the success of community RE systems is demonstrated in Denmark and Australia and elucidated in the chapters by Mey and Diesendorf [65] and Gui-McGill [68], respectively. The World Bank also offers guidelines in designing sustainable off-grid/micro-grid systems [66]. What is crucial is for investors in these new systems to be guided, by official policy, on how to proceed. If the lack of policy instruments for these new systems continues, the Philippines may be foregoing opportunities for a quicker transition to low carbon.

After considering the above challenges, the succeeding section breaks down various entry points and opportunity levers where policy may be able to mobilize the energy sector towards the low-carbon transition.

## 5. Opportunities for energy policy

The government plays a critical role in addressing the trilemma because regulatory frameworks will determine whether investment

decisions are steered towards low-carbon development, or whether they incentivize investments in the cheapest technology regardless of environmental impacts [4,69]. In addition, other key actors like RE developers, financial institutions, environmental organizations, and civil society must also be considered [3,4,24] because, as Fouquet recognized, markets can also lead the transition of certain sectors to low carbon [70]. In governing the transition, the Philippines could pursue two categories of reform simultaneously: rationalization and diversification.

### *5.1. Rationalization*

According to the World Energy Council, “policymaker choice is a key discriminating factor of energy performance [51].” As Foxon and Pearson [71] have noted, “Given that different low carbon technologies are at different stages of technical and commercial development, a completely ‘technology-neutral’ policy framework is probably impossible [71].” Thus, governments need to establish credible long-term frameworks that provide incentives for investment [71]. The Council further recognizes that coherent and predictable sustainable energy transition policies and a stable regulatory and legal framework for long-term investment are interconnected [72]. The rationalization of government policies and procedures will not only reduce political and regulatory risk, but will also encourage, support, attract, and retain investments to achieve energy security, equity, and sustainability goals [33]. This can be done by *first,* deciding on a firm and consistent government direction on energy policy through the creation of a long-term energy plan that can withstand changes in government administrations; *second,* adequately preparing the government to adapt to and accommodate advancements in energy technology by removing unnecessary subsidies tied to specific energy sources while keeping abreast of developments in the international energy platform; and *third,* increasing government-private sector coordination and processing by using energy mapping systems that show optimal areas for energy development vis-à-vis available energy sources and transmission lines [4]. Moreover, red tape in permitting and licensing and delays in regulatory approval must be minimized. Ultimately, rationalization implies a shift from liberalization (or a market-led approach) to a hybrid of government regulation and market-led approach, giving government a greater role in directing energy policy [71].

### *5.2. Diversification*

Reducing the country’s overdependence on *one, imported* resource, coal, entails two courses of action: *first,* optimizing coal’s share in the energy mix, and *second,* reducing the use of imported coal. Currently, the role of coal power plants as baseload plants is crucial and cost-effective because of insufficient renewable sources that can serve as baseload. The problem lies in having a supply of coal plants beyond baseload needs, forcing some coal plants to serve the mid-merit requirement. Efficiency dictates that mid-merit plants are better suited for sources other than coal [46]. To address this, a cap on approved coal endorsements using a portfolio-based *regional* energy plan detailing the baseload, mid-merit, peaking requirements in each of Luzon, Visayas, and Mindanao is necessary. This prevents an oversupply of coal plants beyond baseload needs, and, for the long-term, contractual lock-in of coal supply beyond what is economically, socially, and environmentally acceptable.

However, simply limiting the entry of new coal plants to the baseload needs of the country will not meet sustainability goals. A gold standard for both old and new coal plants also has to be established to control GHG emissions and atmospheric pollutants. The gold standard may be in the form of rigid requirements for new plants such as (1) requirements to use the best available technology (BAT), and (2) stricter emissions standards [74]. The current BAT for coal is the ultra-supercritical plant, which is 20–30% more expensive, but with higher efficiency, than a subcritical plant, resulting in lower fuel costs and emissions [75]. However, the absence of any legislation or executive issuance requiring the BAT means that subcritical plants are still being built. With regard to stricter emissions guidelines, a review of the Clean Air Act is imperative. The standards for sulfur oxide, $CO_2$, $NO_x$, and particulate matter have not been updated since 1999. Furthermore, the current method of direct testing of these emissions has been prone to manipulation, since operators are notified in advance. An alternative to this would be the use of emission factors, continuous emissions monitoring systems, or predictive emissions monitoring systems [74]. This way, inefficient and highly polluting technology in coal plants can eventually be phased out by their inability to compete with newer, cleaner, and eventually cheaper technology. Mauritius’ and Brazil’s experience with diversification of energy supply, which resulted in large macroeconomic benefits for the country [4,24], provides a model for Philippine policymakers to follow and adapt as appropriate.

Once the share of coal has been optimized, policymakers will be able to take advantage of rapid market developments in RE. A portfolio-based approach that utilizes available and indigenous energy sources should be developed and prioritized across the grid, with energy security, equity, and sustainability in mind. Investments in both renewable and non-renewable energy can be considered together because of the interrelationship between the two [76]. For example, natural gas can complement RE to address the latter’s intermittency [44]. Maintaining natural gas’s share in the current energy mix should be the minimum objective, considering the depletion of the Malampaya reserves by 2024–2030. Moreover, a comprehensive natural gas policy and legislative framework must be formulated. The heart of this framework should be the role of natural gas in the energy mix, followed by mechanisms to bolster support for the industry. To illustrate, the construction of liquefied natural gas (LNG) terminals is critical if LNG will be imported after the Malampaya depletion. The policies governing this undertaking and the truck loading of LNG have to be established early. In terms of exploration and development of additional natural gas reserves, DOE can swiftly undertake and fast-track the award of contracts arising from the Philippine Energy Contracting Rounds (PECR). In 2014, there was a PECR for coal, petroleum, and natural gas [78]. Until now, the contracts have not yet been approved and awarded by DOE. One cause of the delay is the hesitation of DOE to award any new contracts pending the legal dispute between the Malampaya consortium and government on who should bear the income tax burden. The resolution of the dispute will not only provide clarity for interested developers, it will also allow exploration of possible reserves to commence.

To increase RE share, the RE Act must be fully implemented, specifically the RPS. A draft circular on the RPS was issued last June 2016; however it has not been finalized to date. The draft circular calls for a national energy mix with at least 35% RE by 2030, and a minimum annual increase of 2.15%. However, before specific percentages of RE penetration and minimum annual increments can be mandated, there must be a stocktaking of available RE plants and of DU supply portfolios. This was raised by industry stakeholders, who expressed concerns that the available RE in the country may be insufficient to meet a steady 2.15% annual increase in capacity. Large electricity consumers have also raised concerns about RE’s ability to catch up with the country’s growing energy demands.

Following this, the ERC should draft an RPS cost recovery framework, establish an RE registrar to monitor the issuance and trading of RE certificates, and establish the RE market to allow trading of RE certificates [77]. Notably, while other jurisdictions choose either just the FIT or just the RPS to stimulate RE investments, the Philippines included both in the RE Act [33]. Marquardt sees this mishmash of regulations from all over the world as being accepted in the Philippines because of donor pressure, despite their unsuitability for the country’s circumstances [33].

RPS encourages competition among different RE sources because

any RE technology can contribute to the quota [79]. As a result, RPS can produce the least cost, and if combined with efficiency measures, could add significant RE generation and fulfill emission cap levels [80]. With the decreasing costs of variable RE, the Philippine government can consider phasing out the FIT and enhancing efforts to finally implement the RPS.

Despite the worldwide trend of investing in variable RE, there is a niche for conventional RE that remains untapped. There is an estimated unexploited capacity of 8,724 MW for hydropower and 1,465 MW for geothermal power in the Philippines [81,82]. To spur investments in these, government can consider providing loan guarantees, drilling failure insurance, lending support mechanisms, cooperative grants, and government-led exploration [83]. Government can also learn from Mauritius, whose targeted, long-term policy packages that were made responsive to stakeholders' concerns allowed niche innovations to grow [4].

### 5.3. Demand-side management

Both the EPIRA and the RE Act comprehensively provide the legislative framework to enhance competition in energy supply and stimulate investment in indigenous energy sources. However, legislation on demand-side management is lacking. Demand-side management includes the promotion of energy efficiency measures, demand response programs, and the like [84].

Energy efficiency (EE) is the "ratio of energy consumed to the output produced or service performed [85]". Measures to improve EE yield higher outputs or services from the same volume of energy. These include green building codes, minimum energy performance standards for equipment and minimum standards for fuel efficiency, electric vehicles, and energy management systems industries [85]. Currently, the Philippines is the only country in Southeast Asia with no law on EE and conservation. Consequently, there is no impetus for businesses to develop energy efficient technologies. Neither is there any urgency for residential and industrial/commercial consumers to purchase energy efficient appliances and/or to retrofit buildings to be energy efficient. It is essential that an EE law be passed, since it is "the quickest and least costly way of addressing energy security, environmental and economic challenges [87]". This legislative measure should consider the EE policies recommended by the IEA, including mandatory building energy codes and minimum energy performance; energy audits and certification schemes; building energy labels; mandatory minimum energy performance standards; phase-out of inefficient lighting products and systems; mandatory vehicle fuel-efficiency standards; fuel-efficient non-engine components; energy efficiency services for small and medium-sized enterprises; and energy utilities and end-use energy efficiency [86]. Defila et al.'s futures wheel is an innovative tool that could provide crucial insights to policymakers wishing to test individual perceptions and concerns about implementing these measures in the Philippines [84].

The EE programs that have already been launched in the country should also be aggressively pursued and promoted through regulation. These include time-of-use [88] and interruptible load programs in distribution utilities [89]; Energy Labeling and Efficiency Standards; ENERCON Programme, to reduce electricity consumption in government offices; Energy Management Program, to conduct energy audits for companies; Heat Rate Improvement Programme for Power Plants, to reduce their fuel consumption) have been developed [86].

Yet, demand-side management is but a small aspect of a greater energy transition strategy called 'change of individual energy consumption behavior' (CIECB), which is further discussed in the chapter by Bornemann et al. (this issue) [90]. According to the authors, CIECB governance must consider individual energy consumption behavior (*e.g.*, use and purchase of energy services or devices) and its influencing factors (*e.g.*, demography, geography, climate, income, age, lifestyle, attitude, norms, values, etc.). A CIECB governance approach in the Philippines could help identify proper policy instruments for ensuring effective demand-side management and incentivizing desired behavior on energy consumption (*e.g.*, amount of consumption, kind of energy resource).

### 5.4. Using the Paris agreement to catalyze the transition

Beyond the energy sector, significant global developments could provide further impetus for the Philippines' energy transition [24]. In particular, the early entry-into-force of the Paris Agreement [91] sends a clear signal to the global community to reduce emissions [3]. As attention shifts from ratification to implementation, the Paris Agreement could be a powerful tool to tip the scale towards the sustainability pillar of the energy trilemma. This, because energy is the biggest contributor to carbon emissions, and so policymakers cannot escape energy policy reform if they wish to achieve Paris goals. The rapid depletion of the world's remaining carbon budget compels countries to do their part in reducing reliance on fossil fuels to reduce carbon emissions [92]. The inextricable link between energy and climate [92] provides an opportunity for a governed transition to low carbon.

## 6. Conclusion and recommendations

In countries that have attempted energy transitions, major policy overhauls were required. An example is Germany's *Energiewende* which required a 180° turnaround of its nuclear policy and the creation of an aggressive policy for renewable energy. Another is China, which has begun shutting down its coal power plants, and has heavily invested in solar, hydropower, and nuclear technologies. What can be seen from these countries is that there is no one-size-fits-all energy transition [24]. Each country selects its priority policy and works towards it while playing to its strengths.

This paper has explored the challenges and opportunities the Philippines has faced in attempting to govern its low-carbon transition. Based on the authors' assessment of the literature review, interviews, expert workshops, and policy dialogue, a set of recommendations are presented: *First,* the Philippines urgently needs a clear, stable, and enduring policy on sustainable energy transition, to spur implementing agencies and local government officials to act and to stimulate private sector investment in low carbon energy technology. *Second,* the implementation of this policy must consider economy-wide effects and must provide flexibility for disruptive technologies in the future. *Third,* low hanging fruits that affect stability and certainty of energy supply must be pursued as soon as possible. *Fourth,* the energy sources for future supply and how they will be used to meet capacity requirements are critical and must be seriously evaluated. *Finally*, the energy mix must be diversified: it cannot be dependent on just one external resource, or be dominated by imported resources; the government must therefore prioritize finding indigenous energy sources. A stable, sustainable energy transition policy that considers the nation's economic growth in the short and long term is absolutely critical in driving a transition to an energy future that addresses security, equity, and sustainability issues. Such a policy can also systematically destroy lock-in conditions and bring the Philippines away from path-dependency on fossil fuels.

While the authors acknowledge that successes in a country depend on its particular circumstances and how well its policies are implemented [51,24], the Philippine experience may nonetheless provide lessons for other developing economies undergoing their own transitions. For example, as Schaube et al.'s study on Argentina shows [93], there are striking similarities between the two countries' current landscape of fossil fuel dependence and great potential for renewables – perhaps policymakers of these two countries could learn from each other's experiences. Delina's study of Thailand [94] also reveals interesting parallels in the socioeconomic context of these two Southeast Asian neighbors as they deal with both climate and energy issues while

promoting rapid economic growth.

As the Philippines prepares itself to become a high-income economy, it must endeavor to meet the concomitant increase in energy demand without compromising its ability to provide a high-quality, reliable, affordable, and more sustainable energy mix which can be easily adjusted to accommodate innovations in technology, and even unexpected changes in economic growth and population. This paper has examined energy policies in the Philippines and described the challenges the country has experienced in attempting to amend such policies to accommodate renewables, particularly focusing on existing technological, institutional, and infrastructure dependence on traditional (fossil fuel) energy sources that have created conditions of lock-in. It has also provided possible ways forward to break away from this path dependency, through rationalization and diversification, and towards the formation of a stable, long-term Philippine energy plan. Although the private sector plays a crucial role in the transformation of the country's energy landscape, particularly because the generation sector has been deregulated and since corporations make the decisions on where to invest substantial financial resources, this paper has shown that the national government and its declared policies play a significant part in the development of the national energy landscape. These policies will steer the direction of the country's energy future. It is thus the responsibility of the national government to provide a clear, integrated, consistent and stable policy direction [95], to engage continuously with the private sector to stimulate low-carbon investment and attain economic growth while balancing the needs for energy security, equity, and sustainability [4]. In parallel, the potential of socio-institutional change to bring about techno-economic changes that could accelerate the transition to low carbon should be pursued [2].

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**References**

[1] B. Sovacool, How long will it take? Conceptualizing the temporal dynamics of energy transitions, Energy Res. Soc. Sci. 13 (2016) 202–215.
[2] B. Sovacool, F. Geels, Further reflections on the temporality of energy transitions: a response to critics, Energy Res. Soc. Sci. 22 (2016) 232–237.
[3] F. Kern, K. Rogge, The pace of governed energy transitions: agency international dynamics and the global Paris agreement accelerating decarbonisation processes? Energy Res. Soc. Sci. 22 (2016) 13–17.
[4] L.S. To, V. Seebaluck, M. Leach, Future energy transition policy for sugarcane bagasse cogeneration: lessons from multi-level and policy innovations in Mauritius, Energy Res. Soc. Sci. 35 (2018).
[5] CNN Philippines, More islands, more fun in PH, 2016. http://cnnphilippines.com/videos/2016/02/20/More-islands-more-fun-in-PH.html (Accessed 15 August 2017).
[6] Philippine Statistics Authority, Statistical Figures, 2015. http://psa.gov.ph/ (Accessed 25 February 2017).
[7] Republic of the Philippines, Intended Nationally Determined Contribution (INDC), submitted to the UNFCCC on 1 October 2015.
[8] World Bank, Population growth (annual%), 2017. http://data.worldbank.org/indicator/SP.POP.GROW (Accessed 25 February 2017).
[9] World Bank, Philippines, 2017, http://data.worldbank.org/country/philippines (Accessed 25 February 2017).
[10] United Nations Development Programme, About the Philippines, (2017) http://www.ph.undp.org/content/philippines/en/home/countryinfo.html (Accessed 25 February 2017).
[11] E. Pernia, The Philippine Economy status quo et status ad quem, [pdf], NEDA Archives., 2016.
[12] R. Remitio, pH is fastest-growing economy in Asia, expands by 6.9% in Q1, (2016) http://cnnphilippines.com/news/2016/05/19/philippines-fastest-growing-economy-asia-gdp-q1.html (Accessed 28 February 2017).
[13] G. Ortega, Philippines seen to become upper-middle-income economy in 6 years, Update Philippines, (2017) http://www.update.ph/2017/01/philippines-seen-to-become-upper-middle-income-economy-in-6-years/13608 (Accessed 28 February 2017).
[14] Asian Development Bank, 2016 Annual Evaluation Review, (2016) https://www.adb.org/sites/default/files/evaluation-document/176420/files/2016-aer.pdf (Accessed 25 February 2017).
[15] F.W. Fuentebella, Efficient Implementation of Power Sector Reforms in the Philippines. Department of Energy (DOE) Presentation during the 5th Philippines Power & Electricity Week on 19 July 2017, Pasay City.
[16] DOE Electric Power Industry Management Bureau (EPIMB), January–June 2016 Power Situation Highlights, DOE Archives.
[18] J. Marquardt, K. Steinbacher, M. Schreurs, Driving force or forced transition? The role of development cooperation in promoting energy transitions in the Philippines and Morocco, J. Clean. Prod. 128 (2016) 22–33.
[19] Centre for Research on the Epidemiology of Disasters (CRED) and The United Nations Office for Disaster Risk Reduction (UNISDR), Poverty & Death: Disaster Mortality 1996–2015, n.d. http://www.preventionweb.net/files/50589_creddisastermortalityallfinalpdf.pdf (Accessed 1 November 2017). See also G.P. Yumul Jr., N. Cruz, N., Servando, C., Dimalanta, Extreme Weather Events and Related Disasters in the Philippines, 2004–2008: A Sign of What Climate Change Will Mean? Disasters, 35:2 (2011) 362–382.
[20] R.B. Kehew, M. Kolisa, C. Rollo, A. Callejas, G. Alber, L. Ricci, Formulating and implementing climate change laws and policies in the Philippines, Mexico (Chiapas), and South Africa: a local government perspective, Local Environ. 18 (6) (2013) 723–737.
[21] P. Mucke, Disaster risk, environmental degradation and global sustainability policy, Alliance Development Works, World Risk Report . [pdf], Bündnis Entwicklung Hilft (Alliance Development Works), Berlin, 2012, pp. 5–9 http://www.ehs.unu.edu/file/get/10487.pdf (Accessed 25 February 2017).
[22] S. Kreft, D. Eckstein, I. Melchior, Global Climate Risk Index 2017: Who Suffers Most from Extreme Weather Events? Weather-related Loss Events in 2015 and 1996–2015, Germanwatch, 978-3-943704-49-5, 2016.
[23] Intergovernmental Panel on Climate Change (IPCC), Climate Change 2014: Synthesis Report, (2015).
[24] L.L. Delina, A. Janetos, Cosmopolitan energy futures: navigating the pluralities and polarities in the energies of tomorrow, Energy Res. Soc. Sci. 35 (2018).
[25] S. Silveira, F. Johnson, Navigating the transition to sustainable bioenergy in Sweden and Brazil: lessons learned in a European and international context, Energy Res. Soc. Sci. 13 (2016) 180–193.
[26] International Energy Agency (IEA), Redrawing the Energy-Climate Map: World Energy Outlook Special Report 10, June 2013. [pdf] France: OECD/International Energy Agency, 2013. http://www .iea.org/publications/freepublications/publication/WEO_RedrawingEnergyClimateMap.pdf (Accessed 01 February 2017).
[27] P. Andrews-Speed, Applying institutional theory to the low-carbon energy transition, Energy Res. Soc, Sci . 13 (2016) 216–225 citing International Energy Agency (IEA), World Energy Report (2009) 3.
[28] G. Unruh, Understanding carbon lock-in, Energy Policy 28 (2000) 817–830.
[29] Republic of the Philippines, An Act Ordaining Reforms in the Electric Power Industry, Amending for the Purpose certain Laws and for other Purposes [Electric Power Industry Reform Act of 2001], Republic Act No. 9136 (2001).
[30] DOE, Presentation, Joint Congressional Power Commission, 16 February 2017, Senate of the Philippines.
[31] Republic of the Philippines, An Act Granting the National Grid Corporation of the Philippines A Franchise to Engage in the Business of Conveying or Transmitting Electricity through High Voltage Back-Bone System of Interconnected Transmission Lines, Substations and Related Facilities, and for other Purposes [NGCP Franchise], Republic Act No. 9511 (2008).
[32] An Act Promoting the Development, Utilization and Commercialization of Renewable Energy Resources and for other Purposes [Renewable Energy Act of 2008], Republic Act No. 9513 (2008).
[33] J. Marquardt, The politics of energy and development: aid diversification in the Philippines, Energy Res. Soc. Sci. 10 (2015) 259–272.
[34] DOE, Promulgating the framework for the implementation of must dispatch and priority dispatch of renewable energy resources in the wholesale electricity spot market, Department Circular No. DC2015-03-001 (2015).
[35] DOE, Energy Data asof 2015, 2015. https://www.doe.gov.ph (Accessed 28 February 2017).
[36] S. Grausz, The Social Cost of Coal: Implications for the World Bank, 2011. http://www.climateadvisers.com/wp-content/uploads/2014/01/2011-10-The-Social-Cost-of-Coal.pdf (Accessed 28 February 2017).
[37] Indonesian Ministry of Energy and Mineral Resources, Coal prices of Indonesia, 2016. http://www.indonesia-investments.com/news/todays-headlines/coal-price-indonesia-at-25-month-high-in-october-2016/item7264? (Accessed 28 February 2017).
[38] Renewable Energy Actof 2008, §§ 3 and 27.
[39] DOE, National Renewable Energy Chapter Program III: Renewable Energy Plans and Programs (2011–2030), (2011), p. 33.
[40] World Energy Council, World Council Energy Resources Survey, (2013), pp. 9.16–9.17.
[41] DOE, National Renewable Energy Program, Chapter III: Renewable Energy Plans and Programs (2011–2030), (2011), p. 41.
[42] Senate of the Republic of the Philippines, Committee on Energy Committee Hearing on Senate Bill 1286, 7 February 2017, Senate Archives.
[43] Parsons Brinckerhoff, Technical Assessment of Operation of Coal and Gas Fired Plants, (2014).
[44] C. Carrao, et al., The Optimal Energy Mix in Power Generation and the Contribution from natural gas in reducing carbon emissionso 2030 and beyond, The Harvard Kennedy School, Discussion Paper 14–63, January 2014.
[45] U.S. Energy Information Administration, Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook, June 2015., 2015. http://www.eia.gov/forecasts/aeo/pdf/electricity_generation.pdf (Accessed 02 February 2017), see Table 10.
[46] Castalia, December 2015, Generation Cost Benchmarking, Consultation Paper,

Energy Regulatory Commission, 2015. http://www.erc.gov.ph/Files/Render/media/CASCON_GENCOSTBEN_FINAL.pdf (Accessed 25 May 2017).
[47] The Lantau Group (HK) Limited, Philippines Natural Gas Master Plan Phase One Report, 29 November 2013.
[48] Manila Electric Company (Meralco), Computation of the Generation Chargefor December 2015 based on November 2015 Generation Costs, 2015. http://corporate-downloadables-rates-archive-generation.s3. amazonaws.com/1449630778.4e4ca904bc0796bcacceecf0f8844714.pdf (Accessed 28 February 2017).
[49] Meralco, Computation of the Generation Chargefor January 2016 based on December 2015 Generation Costs, 2016. http://corporate-downloadables-rates-archive-generation.s3.amazonaws.com/1452217155.cf10f700e69ea2efc89383f3d8c3a22e.pdf (Accessed 28 February 2017).
[50] Meralco, Computation of the Generation Chargefor February 2016 based on January 2016 Generation Costs, 2016. http://corporate-downloadables-rates-archive-generation.s3. amazonaws.com/1455007327.5f865e23959fd22293b1e5b9885fb916.pdf (Accessed 28 February 2017).
[51] World Energy Council, World Energy Trilemma: Defining Measure to Accelerate the Energy Transition, (2016).
[52] B. Sovacool, H. Saunders, Competing policy packages and the complexity of energy security, Energy 67 (2014) 641–651, http://dx.doi.org/10.1016/j.energy.2014.01.039.
[53] L. Hughes, The four R's of energy security, Energy Policy 37 (2009) 2459–2461.
[54] Republic of the Philippines, Philippine Grid Code 2016 Edition (2016).
[55] Lazard, Lazard's Levelized Cost of Energy Analysis – Version 8.0. September 2014, (2014) https://www.lazard.com/media/1777/levelized_cost_of_energy_-_version_80.pdf (Accessed 28 February 2017).
[56] IRENA, Renewable Energy Auctions: Analysing 2016, IRENA, Abu Dhabi, 2017.
[57] Energy Regulatory Commission, ERC Resolution No. 6 seriesof 2015; Solar Projects under FIT System with Certificate of Commerciality as of 31 December 2016, 2016. https://www.doe.gov.ph (Accessed 17 May 2017).
[58] In The Matter of the Application for Approval of the Feed-in Tariff Allowance (FIT ALL) for Calendar Year 2016 Pursuant to the Guidelines for the Collection of the Feed-in Tariff Allowance and Disbursement of the Feed-in Tariff Allowance Fund, with Prayer for Provisional Authority. ERC Case No. 2015-216 RC. Decision dated 9 May 2017.
[59] Senate of the Republic of the Philippines, Transcript of the Joint Congressional Power Commission hearing. 9 May 2017. Senate Archives.
[60] D. Rivera, Solar Developers' Group Crafts Framework for Future Solar Projects, The Philippine Star, 2016 26 December 2016. http://www.philstar.com/business/2016/12/26/1656755/solar-developers-group-crafts-framework-future-solar-projects (Accessed 11 February 2017).
[61] Senate of the Republic of the Philippines, Explanatory Note of Senate Bill 1286 entitled An Act Establishing The Virtual One Stop Shop For The Purpose of Streamlining The Permitting Process of Power Generation Projects 17th Congress.
[62] P. Alstone, D. Gershenson, D. Kammen, Decentralized energy systems for clean electricity access, Nat. Clim. Change 5 (2015) 305–314.
[63] National Power Corporation Statistics, Senate Archives, 2017.
[64] Philippine Solar Alliance, Transcript of Senate Committee on Energy Hearing on 7 February 2017. Hearing of the Senate Committee on Energy. Senate Archives.
[65] F. Mey, M. Diesendorf, Who owns an energy transition? Strategic action fields and community wind energy in Denmark, Energy Res. Soc. Sci. 35 (2018).
[66] E. Terrado, R.A. Cabraal, I. Mukherjee, Designing Sustainable Off-Grid Rural Electrification Projects: Principles and Practices, The World Bank, 2008.
[67] S. Sareen, Energy distribution trajectories in two Western Indian states: comparative politics and sectoral dynamics, Energy Res. Soc. Sci. 35 (2018).
[68] E.M. Gui, I. McGill, Typology of future clean energy communities: an exploratory structure, opportunities, and challenges, Energy Res. Soc. Sci. 35 (2018).
[69] J.V. Cabuenas, Contrary to DENR Chief's Stand, Coal-fired Power Plants Are Acceptable to DOE, GMA News, 2016 http://www.gmanetwork.com/news/story/572323/money/companies/coal-fired-power-plants-are-acceptable-to-doe (Accessed 15 February 2017).
[70] R. Fouquet, Historical energy transitions: speed prices and system transformation, Energy Res. Soc. Sci. 22 (2016) 7–12.
[71] T.J. Foxon, P. Pearson, The UK low carbon energy transition: prospects and challenges, Working Paper vol. 2013/3, University of Bath, Bath, 2013 http://orca.cf.ac.uk/60247/1/RTP_WP_2013_3_Foxon_x_Pearson_UK_low_carbon_energy_transition.pdf (Accessed 15 February 2017).
[72] World Energy Council, World Energy Trilemma: Time to get real – the case for sustainable energy investment, (2012).
[74] L.L. Sloss, Efficiency and Emissions Monitoring and Reporting, IEA Clean Coal Centre, 2011.
[75] D. Santoianni, Setting the Benchmark: The World's Most Efficient Coal-Fired Power Plants, (2015) http://cornerstonemag.net/setting-the-benchmark-the-worlds-most-efficient-coal-fired-power-plants/ (Accessed 11 Ausust 2016).
[76] E. Baranes, J. Jacqmin, J.C. Poudou, Non-renewable and intermittent renewable energy sources: friends and foes? (2015).
[77] Renewable Energy Actof 2008, §§ 6, 8.
[78] DOE. Department Circular No. DC2014-02-0005, Reiterating the Transparent and Competitive System of Awarding Service and Operating Contracts for Petroleum and Coal Prospective Areas, Repealing for this Purpose Department Circular Nos. DC2011-13-0020 and DC2012-02-00 (24 January 2014). The results of PECR5 (2014) can be accessed at https://www.doe.gov.ph/download.
[79] C.G. Dong, Feed-in tariff vs. renewable portfolio standard: an empirical test of their relative effectiveness in promoting wind capacity development, Energy Policy 42 (2012) 476–485.
[80] L. Bird, C. Chapman, J. Logan, J. Sumner, W. Short, Evaluating Renewable Portfolio Standards and Carbon Cap Scenarios in the U.S. Electric Sector. Technical Report NREL/TP-6A2-488258, National Renewable Energy Laboratory, 2010.
[81] International Hydropower Association, 2016 Hydropower Status Report, (2016) https://www.hydropower.org/2016-hydropower-status-report (Accessed 11 February 2017).
[82] A.D. Fronda, M.C. Marasigan, V.S. Lazaro, Geothermal Development in the Philippines: The Country Update, Proceedings World Geothermal Congress, April 19–25, 2015, Australia, 2015.
[83] B. Speer, et al., Geothermal Exploration Policy Mechanisms: Lessons for the United States from International Applications, National Renewable Energy Laboratory, 2014.
[84] R. Defila, A. Di Giulio, C.R. Schweizer, Two souls are dwelling in my breast: uncovering how individuals in their dual role as consumer-citizen perceive future energy policies, Energy Res. Soc. Sci. 35 (2018).
[85] Organisation for Economic Co-operation and Development/International Energy Agency, Capturing the Multiple Benefits of Energy Efficiency, (2014) p. 29, http://www.iea.org/publications/freepublications/publication/Captur_the_MultiplBenef_ofEnergyEficiency.pdf (Accessed 26 May 2017).
[86] United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), Assessment Report on Energy Efficiency Institutional Arrangements in Asia, (2010).
[87] International Energy Agency, 25 Energy Efficiency Policy Recommendations, (2011) https://www.iea.org/publications/freepublications/publication/25recom_2011.pdf (Accessed 26 May 2017).
[88] DOE. Department Circular No. DC2014-08-0014 Enjoining All Electricity Consuming Sectors to Implement Demand-Side Management Program and Other Energy Conservation Measures (11 August 2014).
[89] ERC. Resolution No. 8 Seriesof 2010, amended through ERC Resolution No. 8 Series of 2013.
[90] B. Bornemann, A. Sohre, P. Burger, Future governance of individual energy consumption behavior change: a framework for reflexive designs, Energy Res. Soc. Sci. 35 (2018).
[91] N. Keohane, Paris Agreement Enters into Force in Record Time, Marking Continued Global Momentum on Climate Action, Environmental Defense Fund (EDF), (2016) https://www.edf.org/media/paris-agreement-enters-force-record-time-marking-continued-global-momentum-climate-action (Accessed 25 February 2017).
[92] G.A. Lenferna, Can we equitably manage the end of the fossil fuel era? Energy Res. Soc. Sci. 35 (2018).
[93] P. Schaube, W. Ortiz, M. Recalde, Status and future dynamics of decentralised renewable energy niche building processes in Argentina, Energy Res. Soc. Sci. 35 (2018).
[94] L.L. Delina, Whose and what futures? Navigating the contested coproduction of Thailand's energy sociotechnical imaginaries, Energy Res. Soc. Sci. 35 (2018).
[95] R. Fouquet, Lessons from energy history for climate policy: technological change demand and economic development, Energy Res. Soc. Sci. 22 (2016) 79–93.
[96] ERC. Rules on Customer Switching, Case No. 2006-024 RM.
[97] D.A. Layugan, Retail Competition and Open Access, ERC Archives, 2016.

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